REFRIGERATING OR FREEZING APPARATUS WITH VACUUM COMPARTMENT

TECHNICAL FIELD

The present invention refers to a refrigerator and/or a freezer provided with a compartment in which vacuum is produced by means of a vacuum pump.

BACKGROUND

It is well known that the cold preservation of foods under vacuum offers considerable advantages. In particular, it enables such foods to be kept in a refrigerator or the like with considerably slowed degradation. With particular reference to household refrigerators, various methods have already been proposed for providing in the refrigerator a compartment having its own door and connected to a vacuum pump (see, for example, FR-A-1 3 77 844).

In the prior art it is generally known that in a refrigeration compartment of a refrigerator, freezer or the like there is provided a container closable in a vacuum-tight manner and able to be moved within said compartment, said container being provided with a pipe through which the vacuum is produced and which is arranged to cooperate with a counter-pipe provided in the usual cabinet of the refrigerator or the like and opening into a wall of said compartment, said counter-pipe being connected to the vacuum pump, at least one of the cooperating ends of said pipes comprising a hollow elastic element arranged to form a seal against the other end.

This method results in various advantages such as considerable constructional simplicity of the refrigerator, low production cost, ease of access to the compartment in which the vacuum is provided, and ease of its cleaning.

However, such a construction has various drawbacks, such as the possibly imperfect closure of the lid of the container during its reinsertion into the refrigeration compartment after being extracted from it, and possibly imperfect

connection between the pipe associated with the container and the relative counter-pipe.

From US 2,119,320 a refrigerator is disclosed with means for maintaining a partial vacuum in the food compartment including a suction pump to draw air out the same compartment and also to draw off odours; means are comprised which are automatic in their operation so that when the refrigerator is opened they will permit air to rush into the food compartment and raise the pressure therein to atmospheric pressure.

However, the whole food compartment, and not only a separate container, different from said compartment, is subjected to the vacuum operation so that, if the user wishes to store the food in the refrigerator compartment without subjecting it to the vacuum, this way of operation is impossible to be achieved. Furthermore the handle to open the door is associated to a mechanism, to let the air into the compartment, which is complicated and burdensome.

In US 2002/0083724 A1 a food storage and preservation system is disclosed showing a plurality of food storage containers each having related door, related vacuum associated devices, and a centralised air treatment module comprising a vacuum pump and switch sensor that activates when a container door opens or closes; this food system is created to stay both inside or outside of a refrigerator.

Then it is not functionally optimised to work inside a refrigerator compartment only; furthermore it is expandable and modular, while said features do require technical and operating features that are not acceptable in a refrigerator apparatus for household use.

From US 6,090,422 a refrigerator is known which comprises a vacuum cabinet, which includes a vacuum compartment and an open top drawer in the vacuum compartment. The suggested solution is basically well known in the art, with the adding of a timer, operated by the door closing, and automatically controlling the vacuum pump operation. Said refrigerator suffer the drawback that the venting

means to the atmosphere comprise a pushing valve that has to be operated manually each time the vacuum compartment is pulled out; this operation may be uneasy and also may be often forgotten, thus not making the vacuum compartment user friendly.

From EP 0440296 a refrigerator is known which comprises a vacuum cabinet which includes a vacuum compartment and a drawer in the vacuum compartment, said compartment being associated to a related top lid; even in this case the vacuum compartment is complicated both to be produced and to be operated, as the lid has to be automatically disengaged while the drawer is pulled-out, and remains inside the refrigeration compartment, while the drawer stays outside it. All that implies complicated mechanical means as especially showed in the figures 3 and 4 of the relevant patent.

An object of the present invention is therefore to provide a refrigerator or the like comprising a movable container internally under vacuum, which obviates the drawbacks of known constructions. A particular object is to provide a refrigerator with a vacuum container type where the operation of the vacuum valve is controlled by the same handle used to open/close the door.

A further object is to provide a refrigerator of the aforesaid type, where the same handle is also used to operate the vacuum pump according to the same handle operation. Another object of this invention is to arrange such type of refrigerator so as, alternatively from the just given solutions, said vacuum pump and/or said vacuum valve are operated by the closing movement of said drawer into said box.

According to the present invention, these aims are reached in a refrigerator or a freezer apparatus having the features disclosed in the appended claim 1.

DESCRIPTION OF DRAWINGS

Further advantageous features will become apparent and may be readily understood by the following description, which is given below by mere way of not-limiting example with reference to the accompanying drawings, in which:

Figure 1 is a vertical side section through a domestic refrigerator constructed in accordance with a first embodiment of the invention,

Figure 2 is a corresponding side section of a similar refrigerator according to a second embodiment of the invention,

Figure 3 is a perspective partial view of the inner part of a refrigerator according to the invention, in a first operative condition,

Figure 4 is a perspective partial view of the inner part of a refrigerator according to the invention, in a second operative condition,

Figures 5 and 6 are vertical side partial views of a drawer according to a first embodiment of the invention, in respective different stage of its use,

Figures 7 and 8 are vertical side partial views of a drawer according to a second embodiment of the invention, in respective different stage of its use,

Figure 9 is a schematic view of a refrigerator according to a further embodiment of the invention,

Figures 10 and 11 are schematic enlarged views of a particular feature of the refrigerator according to the embodiment shown in Figure 9, in two different operative conditions, respectively.

DESCRIPTION OF AN ILLUSTRATIVE EMBODIMENT

With reference to Figures 1 and 2, respectively, a refrigerator or freezer comprises a cabinet 1 containing a refrigeration compartment 2 and a freezer compartment 3, each provided with its closure door 4 and 4a, respectively. The refrigerator is also provided with a box 5 wherein a drawer 6 that can be inserted or extracted.

A vacuum pump 7, operated by an electric motor, not shown, and positioned in

the back lower side of said cabinet 1, is connected to said box through a pipe 8 extending through a back wall 9 of said box 5. To said vacuum pump is associated a vacuum valve 13, normally consisting of a regulated pressure valve or similar well known in the art, whose function and structure are not further explained, whereas the operation of this valve 13 will be described in detail hereinafter.

The box 5 is maintained in known manner at a specified temperature, being substantially lodged into said refrigerated compartment 2 or being in some way externally lapped by a flow of cold air. Said box 5 can be opened directly from the outside, and it can be accessible without opening the compartment closure door 4, as exemplified in Figure 2; as an alternative to this "drawer-type" embodiment, the whole box 5 may be fully contained in the compartment 2, so that if the user wants to open it, he has to first open the external door 4b and then he can act on a box closing wall 10 (Fig. 1) of the drawer 6.

The front closing wall 10 protrudes from the general contour of the drawer 6, and the dimensions and arrangement of the box 5, the drawer 6 and the front closing wall 10 thereof relative to each other are so selected as to ensure that said drawer is capable of being fully inserted in said box up to the point at which the back surface 12 of said front closing wall 10 comes into abutting against the peripheral edge 11 of said box 5 (Fig. 5-8), thereby closing the latter in a vacuum-tight manner.

As shown in Figures 5 and 7, the actual vacuum-tightness can be ensured by arranging appropriate sealing means 14 either against and along the peripheral edge 11 of the box 5 or, alternatively, in the most appropriate position according to the most fitting pattern of the back surface 12 of the front closing wall 10. In order to close and/or open said drawer by separating it from said box 5, said front closing wall 10 is provided with a pivotally turning handle 15 which is hinged on two corresponding hinging pins 16 arranged on the two opposite, vertical sides of said front closing wall 10. As a result, this handle 15 is made capable of performing a raising and lowering movement about the horizontal axis passing through said two pins 16, as illustrated symbolically in Figures 3 and 4.

The handle 15 is further provided, at its inner ends, with two respective extension links 17 (Fig. 5-8), which are curved in such manner as described in greater detail below. On the two sidewalls of said box 5, there are further arranged two engagement means, which are represented by two projections 18 in the example being considered. The shapes, dimensions and arrangement of the above noted elements relative to each other are so selected as to ensure that, upon the drawer 6 having been pushed into its closed position, wherein it is preferably pushed with the use of said handle 15 on the front side thereof, by subsequently turning the same handle 15 downwards said extension links 17 are caused to engage the respective projections 18 in such a manner as to retain said front wall 10 in the closing position thereof (see Figures 6 and 8).

Said extensions 17 will of course engage the corresponding members 18 by establishing a kind of semi-elastic, loosable link, so that it will be possible for this link to be released for pulling out and opening the drawer by simply lifting said handle 15, i.e. turning it upwards, so as to release said extension links 17 from the respective projections 18.

When said drawer 6 and the respective handle 15 are in the closed position thereof, the same drawer is separated in a tightly sealed manner from the outside ambient, so that a vacuum can be generated inside it using generally known means. However, when the drawer has for any reason to be opened, i.e. pulled out from its closed position, the need most obviously arises for the internal pressure of the drawer to be first equalised to the pressure of the outside ambient. To this purpose, different solutions have been proposed and used in the prior art, all of which share the fact that said restoration of the inner pressure to ambient value is performed by the actuation of a specially provided control device.

The need for such a special control device to be used gives rise to a couple of major drawbacks: the first one of these drawbacks is represented by the same air release device, which may in fact be subject to deterioration and, as a result, may eventually constitute an undesired route for the air to pass through, while the

second one of said drawbacks certainly lies in the fact that, before the drawer can be pulled out and opened, the need arises for said additional manipulation to be performed in view of operating said air release control device.

In view of doing away with both such major drawbacks, an improved embodiment of the present invention provides for said vacuum valve 13 to be so arranged as to be capable of being acted upon in such a manner that, as soon as the drawer 6 starts to be opened, and therefore as soon as the handle 15 is lifted, the resulting rotary movement of said extension links 17 causes the latter to act on an electric switch 19, which is preferably located on the outside of said box 5 in a position close to the respective projections 18.

Said electric switch 19 is connected via an appropriate link-up 20 to said vacuum valve 13, in such a manner that, as soon as said handle is operated, the release movement of the members 17 and 18 to disengage from each other is preceded by the actuation of said switch 19. This causes said vacuum valve 13 to open, so as to almost instantly restore the internal pressure of the drawer to the ambient value. In this way, the continued turning movement of the handle eventually enables the drawer to be released from its box 5.

Furthermore, the switch 19 is also connected to said vacuum pump 7 via appropriate electrical connections (of any known kind and not shown). Upon the drawer having been so released from the box, it can then be pulled out by simply pulling it with the help of the handle 15.

Closing the drawer and re-establishing a vacuum inside it are on the contrary performed as follows: the drawer is inserted all the way into its box 5 and, immediately thereafter, the handle 15 is turned down, thereby achieving the following results:

- the drawer is blocked in position in the box 5,
- the extension link 17 acts on the switch 19,
- the latter, via said connection 20, causes the vacuum valve to enable the vacuum-tightness of the internal volume of the drawer to be restored,

- the same switch 19 outputs an appropriate signal to the vacuum pump 7, so as to cause it to switch on to create vacuum inside the box 5 and, as a result, inside the drawer 6.

In this manner, through the sole and simple operation of the handle 15 it is possible for both:

- the pressure inside the box 5 to be equalised prior to the drawer being pulled out, and
- the drawer itself to be closed in a tightly sealed manner and, at the same time, the vacuum pump 7 to be switched on immediately upon said drawer being inserted in the box 5.

The above illustrated solutions concerning the electric switch 19 may also be embodied in different forms and manners. In fact, with reference to Figures 7 and 8, instead of the switch 19 arranged laterally on the box 5, use can be made of an equivalent switch 19A arranged again on the outside of the same box 5, namely so as to project from the front edge 21 of said box towards the back surface 12 of said front closing wall 10. This switch must in this case be so positioned and oriented as to enable it to be actuated by the same front closing wall 12 of the drawer 6 when the latter is pushed into closing. The operation of this switch and the connections thereof with the vacuum valve and the vacuum pump are the same as the ones that have been just described above, since they are in both cases arranged and adapted to detect the final phase of the closing movement and the initial phase of the opening movement of the drawer relative to its containment box 5, so that they shall not be described here any further.

Of course, it is apparent that the above described solutions may be further adjusted; for instance, instead of a horizontal handle 15, there can be installed and used a vertical handle on condition that projections 18 are appropriately positioned on the box 5.

The configuration that is generally represented and illustrated in this specification, and which makes use of a box 5 that is firmly mounted inside the cold storage compartment 2 of a refrigeration apparatus, as well as a drawer 6 that is capable of

being pulled out of said box, allows for a further improvement to be implemented, which certainly proves as being particularly advantageous under certain circumstances. It may in fact happen that certain kinds of foodstuffs being kept stored for prolonged periods of time may give out gases (e.g. carbon dioxide) or, anyway, odours and even transudation liquids, which, apart from being anyway unpleasant, generally make the storage and preservation conditions of the same foodstuffs worse and far less favourable. These occurrences may further become considerably more marked in the case that the same foodstuffs generating such emissions is being kept in an ambient under controlled vacuum conditions.

In other words, if such foodstuffs are kept stored under vacuum conditions for a certain period of time, gases are likely to be generated in the same storage ambient, which would be better removed therefrom.

The above-cited improvement takes care of this by providing for said regulated pressure valve 13 (Fig. 1) to be in fact connected to control means (of any known kind, not shown), which is adapted to periodically energise said valve 13 and said vacuum pump 7, so as to cause them to operate according to the following cycle:

1. At a pre-determined time elapses, the regulated pressure valve 13 is switched on to open, thereby allowing ambient air to flow into said box 5 and eliminating the vacuum therein; during this time the vacuum pump 7 is switched off, i.e. does not operate
2. Next, and preferably after a short pre-determinable time, the regulated pressure valve 13 is operated so as to close the passage to the outside ambient and connect the interior of the box 5 with the vacuum pump 7
3. At this point, the vacuum pump is switched on to operate, so as to re-establish vacuum conditions inside the box 5.

It can be readily appreciated that, by performing the above cycle periodically, the box 5 is ventilated and, in particular, the gases possibly existing therein are removed periodically, owing to them mixing up with the inflow ambient air, which is in turn removed from said box 5 by said vacuum pump 7 soon thereafter.

The manner in which the various parts and members involved and the related connections may be made and implemented is fully apparent to and within the abilities of those skilled in the art, so that it shall not be described here any further. In particular, control means 30 (Figure 2) may be advantageously integrated with more general control and regulation means that are already present in the refrigeration apparatus. Furthermore, said regulated pressure valve 13 may be most easily implemented with the use of a simple three-way valve of a kind that is well known as such in the art.

A refrigerating apparatus as described allows further advantageous improvements; in the facts even if the positive effect on food storage under vacuum condition is well known, yet the vacuum devices are not usually available in the domestic environment; so the food producers directly provide their food products properly packaged under vacuum conditions. These kind of packaging consist of hermetic soft bags, mainly made of plastic sheets, from which air is withdrawn and soon after they are sealed and closed.

The embodiment of the present invention offers the possibility of arranging vacuum bag packages directly at home.This improvement is obtained as follows:

A dispenser 41 is pivotally mounted on the external wall 40 of the refrigerating apparatus according to the instant invention; said dispenser 41 consists of a prolonged member, internally provided with an hollow duct 42, opened at the outside with a mouth 43, and opened towards said wall 40 with a mouth 44 (Figures 9 and 10).

Close to said mouth 44, said dispenser is provided with a hinge element that connects said dispenser with said external wall 40 in a rotating way. On this external wall 40 is provided a second duct 46 connected to a part of said apparatus that is normally kept under vacuum condition; this part may be, e.g. the same box 5 or a stretch of said duct 8 connected to said vacuum pump 7, or even to a buffer tank 25 that will be better described hereunder.

In any case said second duct 46 is apt to intake the outside air from its external mouth 47, that, on the outside, is associated to a gasket 49. The described elements are sized and reciprocally arranged so that:

- under still conditions (Figure 10) the dispenser 41 is rotated downwards around the hinge, and in this position its pivotal end, close to said mouth 44, closes the faced mouth 47 of said second conduit 46, even for the effect of said gasket 49 pressed by the end of the dispenser;
- under working condition (Figure 11) the side 50 is turned away and said two conduits 42 and 46 are placed into alignment so that the mouth 44 of the dispenser 41 is brought in front of said mouth 47 of the second conduit 46; therefore said two conduits are automatically connected, so implementing a unique open way.

At this point the operation will be apparent to the person skilled in the art. When the dispenser is pushed downwards, there is no connection between the conduits 42 and 46, and therefore there is no air suction. When the user wants to create vacuum conditions in a bag containing food (not shown in the figures), he has to lift the dispenser by rotating it around the hinge element (to an extent not enough to make said mouth 47 of said second conduit 46 open into said first conduit 42), then the bag opening has to be applied around the external mouth 43 of the dispenser, then said opening is clasped and closed to said mouth 43 so that any air passage from the dispenser to outside is prevented. Afterwards, the dispenser is still lifted in such a way that said conduits 42 and 46 are put into alignment so that said mouth 47 of said second conduit 46 is open into said first conduit 42.

As a consequence the air contained in said bag is at once sucked into said first conduit 42 and second conduit 46, from which it is evacuated away in the remaining portion of said conduit 46, till the vacuum condition in the bag is achieved. The operation continues by hermetically closing the bag opening in a position where the dispenser is not involved, by pushing down the dispenser, and finally by taking away the bag.

It will be understood by a person skilled in the art to replace the hinge-mounted dispenser with another kind of dispenser (not disclosed in any drawing) in order to

achieve a vacuum-creating feature for the user. Such a dispenser may for instance comprise a mouthpiece which could be operated in a vertical direction in parallel with the direction of the airflow creating the vacuum. The mouthpiece is preferably spring loaded to keep the mouthpiece in a normally closing position. Moving the mouthpiece vertically will open the mouth 47 in order for air to flow. Preferably, said alternative dispenser could both replace the dispenser illustrated in fig. 10 and 11 and also the container for collecting liquid described below in order to create a more user-friendly solution. The gravity will also in this solution create the liquid-air separation.

In order to avoid that incidental liquids, as exudates, juices, etc. be withdrawn from said food bag into said second conduit 46, that would be dangerous for the hygienics of the whole apparatus, and for the vacuum pump safety, a further improvement is in described hereinafter. In the back face of said wall 40 a trap for liquid is provided, that is basically formed by:

- a container 51 provided with a first opening 52 and a second opening 53,
- said first opening 52 being connected to the portion 46a of said second conduct 46 turned to said wall 40,
- said second opening 53 being connected to the portion 46b of said second conduct 46 turned to the opposite way,
- said first opening 52 being placed at a slightly higher position (level) than the second opening 53.

It is then apparent that said trap is able to collect the liquids incidentally entering through said portion 46a, as they would fall by gravity on the bottom of said container 51, so preventing them from entering into the second conduit 46b and from it to the vacuum pump 7 and even to the box 5. Of course said container is provided with means, not shown, that, when needed, can permit to open the same container and to evacuate the liquids possibly there stagnating.

When the liquids are not taken away in the right time, it is possible that the liquid level will rise until it reaches the level of said second opening 53; in order to avoid that said liquid enters into said portion 46b, a ball valve 55 is provided close

to the opening 53. Said valve is arranged in such a way that, when the liquid level 54 approaches the level of said second opening 53, the ball valve 55 will float and rise until it will close said opening 53, so achieving the requested safety.

It is also understood that appropriate means 56 are provided that are suitable to lead said ball valve exactly in front and against said second opening 53 while the liquid level would rise; however said means are well known in the art and therefore will not further described.

A drawback that can be experienced during the working of a refrigeration apparatus as described refers to the evacuation rate of the box 5 and especially to the air suction in the bag as previously described; said drawback is due to the fact that the vacuum pump has to be necessarily sized in the volume and in the produced noise, and so its suction ability must be limited and as a results this increases the time requested for the vacuum done.

Furthermore it has to be considered that if the drawer 6 is not evacuated in a very short time and if the gasket 22 is not perfectly closed when the air is not yet fully drawn out of the box 5, then it may easily happen that the hermetic sealing of the gasket 22 and so the desired vacuum condition may be prevented, due to the lack of the atmospheric pressure on the outside surface of the front door 10.

An advantageous solution to said problem is now given. With reference to Figure 9, to the refrigerating apparatus according to the invention is associated a buffer vacuum tank 25, i.e. an hermetic chamber that is inserted in the pipe connecting the vacuum box 5 to the vacuum pump 7. Furthermore, a control valve 28 is positioned between the vacuum box 5 and the buffer vacuum tank 25, while said vacuum valve 13 is arranged between the buffer vacuum tank 25 and the vacuum pump 7.

Said valves 13 and 28 are connected and controlled by said control means mentioned before (Figure 2), so accomplished and connected in order to permit their functioning according to the following procedure:

1. At the beginning and in stationary condition both valves 13 and 28 are open, the drawer 6 is closed into its box 5 and both of them are under vacuum conditions; successively the drawer 6 is opened (pulled) so as to activate said switch 19 (or 19A);
2. The electric signal coming from said switch 19 is send to said control means, that works out said signal and sends a closing signal to the control valve 28, that immediately closes, so cutting off said buffer tank 25 from said box 5;
3. After having been used, said drawer 6 is re-inserted in the box 5 and the switch 19 is again activated;
4. Following said operation the control means 30 send a proper signal to said control valve 28, so that it is immediately opened;
5. As a consequence the air contained in the drawer 6 is automatically drawn out from the vacuum existing in said buffer tank 25, and the fact creates an immediate depression in the drawer 6, so helping the hermetic closing of the same drawer, so achieving the desired purpose.

Of course the same activation of the switch 19 makes the vacuum pump 7 also to operate, according to the disclosed procedure.